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(54) **Optical media with control data in wobble**

Optische Medien mit Steuerdaten in einem Wobbel

Support optique avec données de commande dans des oscillations

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Description

BACKGROUND

[0001] Technical Field: The invention relates generally to optical media used for information storage, and drives for reading optical media used for information storage.

[0002] Digital optical media are used for a variety of purposes and a variety of information, for example, entertainment data, such as audio and video, and computer data, such as text files and numerical data files. In general, a drive or a host system may request specific data from the physical medium, and there is a need for control of access to some specific data, and a need to control the actions of the drive. For entertainment data in particular, there is a general need for copy protection, copy control, security of decryption keys, and restriction of access to data that is not encrypted. For example, in an integrated entertainment system, a drive reading encrypted data may decrypt the data internally and send the resulting data to an integrated display. If the drive is peripheral to a display, the drive may be required to send encrypted data to the display, where the data is then decrypted inside the display. As an additional example, some video disks are intended for use only in specific geographic regions, and only trusted drives should be permitted to read the restricted video data. There is an ongoing need for control of access to information stored on optical media.

[0003] US 2004/223427 A I discloses a recording medium, an apparatus for forming the recording medium, and an apparatus and method for reproducing the recording medium. CPI (Copy Protection-related Information), identification information (CPI_Flag) indicative of recording or non-recording of the CPI, and/or a plurality of contents specific information (CSI) with different formats are recorded in a PIC (Permanent Information & Control data) zone of a high-density optical disc such as a BD-ROM (Blu-ray Disc-ROM). A formatting operation and mastering operation are performed under the condition that control data including the CPI, CPI_Flag and/or CSI is separated from main data. An optical disc device judges whether the optical disc has been illegally copied, with reference to the CPI, CPI_Flag and/or CSI read from the optical disc, and compulsorily stops a data playback operation upon judging that the disc has been illegally copied. First CSI stored in PIC is compared to second CSI stored in other area and the disc is judged to have been made through an illegal process in case same do not match.

[0004] EP 0997899 A2 discloses an optical disk comprising a first recording area for recording contents data and data for recording and reproducing the contents data, and a second recording area for recording secondary data on the contents recorded in the first recording area, the secondary data being recorded as stripe marks longer in radial direction. Further, the second recording area comprises a first section for recording control data on the second recording area, a second section for recording data not to be inhibited to be outputted from a recording and reproducing apparatus for the optical disk, and a third section for recording data to be inhibited to be outputted from a recording and reproducing apparatus. The control data recorded in the first section includes an identifier which shows whether said second recording area includes said third section or not.; By using the data to be inhibited to be outputted in the second recording area, a copyright of contents is protected and illegal use of software is prevented. Watermarking is used to avoid reproduction of video signals not including correct hidden information.

[0005] WO 2004/095439 A1 discloses a method for managing copy protection information of a recording medium. A hidden code and a disc key may be recorded in the form of a physical wobble on the recording medium.

[0006] BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1A illustrates an example system in which the invention may be implemented.

[0008] Figure 1B illustrates an example of information encoded in wobble on a disk in the system of figure 1A.

[0009] Figure 1C is a plan view of an optical disk illustrated in figure 1A, with examples of regions of control information and regions of auxiliary information.

[0010] Figure 2 is a flow chart of an example embodiment of a method for using control data encoded in wobble.

[0011] Figure 3 is a flow chart of a second example embodiment of a method for using control data encoded in wobble.

[0012] Figure 4 is a flow chart of a third example embodiment of a method for using control data encoded in wobble.

[0013] DESCRIPTION

[0014] For some digital optical media for information storage, for example some Compact Disks (CD's) and Digital Versatile Disks (DVD's), each data surface has a land and groove structure, with the lands and/or grooves having a sinusoidal radial displacement (called wobble). User information (for example, audio data, video data, or computer data) may be recorded in the grooves, on the lands, or both. Additional system information (for example format information, control information, and auxiliary information) may be encoded in the wobble. For example, in CD's, groove wobble is frequency modulated to encode time information. In more recent DVD's, wobble may be frequency or phase modulated to encode address information and additional auxiliary information, for example, decryption keys.

[0015] In example embodiments of the invention, control data encoded in wobble on an optical medium specifies drive action. Depending on the control data, a drive is prohibited from taking, or permitted to take, or required to take, or requested to take

[0016] specified action with auxiliary information encoded in wobble. In a first example, control data, encoded in wobble, specifies whether a drive is permitted to send

auxiliary data, also encoded in wobble, outside the drive. In a second example, control data, encoded in wobble, specifies whether a drive is permitted (or required) to copy auxiliary data (or a transform of the auxiliary data), encoded in wobble, to a writeable area on the medium. In a third example embodiment, control data, encoded in wobble, specifies whether a drive is requested to compare auxiliary data, encoded in wobble, to data written in a writeable area of the medium.

[0017] Figure 1A illustrates an example embodiment of a drive 100 including an optical disk 102. An optical head 104 views a land and groove structure on the disk 102 through a lens system 106. A controller 108 transforms signals from the optical head 104 into digital information. The digital information includes user data and information encoded in wobble. The controller 108 is in communication with a host device 110. The drive 100 may be part of the host 110, or optionally the drive may be a peripheral device connected to the host by a cable as illustrated, or optionally the drive may be a peripheral device and communicate with the host wirelessly.

[0018] Figure 1B illustrates a data track 112 on the disk 102 with radial wobble (exaggerated for illustration). In the example of figure 1B, the phase of the wobble is inverted at location 114. Patterns of phase inversions define binary ones and zeros, and information is encoded in the patterns of phase inversions of wobble. Alternatively, wobble may be frequency modulated to encode information. There are other ways in which information can be encoded into wobble or other physical structures on the disk used for addressing, physical tracking, or formatting purposes, and for purposes of the present invention, the particular encoding method is not important. In figure 1B, user data, and/or the writeable area on the disk, is located on the data track 112 between the areas of wobble. Note that wobble in figure 1B is illustrated as being symmetrical on each side of the data track 112. Symmetrical wobble is most common, but in general, wobble may be asymmetrical, or on only one side of the data track.

[0019] The disk 102 may have, for example, a single spiral track, or may have, for example, multiple concentric tracks. For purposes of the present invention, the number of tracks is not important. Figure 1C illustrates a region 116 (or portion, or segment, or

[0020] block) that is part of a track on the optical disk 102. Region 116 contains auxiliary information encoded in wobble. For convenience of illustration, the region 116 in figure 1C is illustrated as about one-fourth of a rotation of the disk. However, the word "region" is intended to mean a subset of a track or tracks. That is, the information encoded in wobble in the region 116 is a subset of the total information encoded in wobble for an entire track (if there is a single spiral track) or set of tracks (if there are concentric circular tracks). Also illustrated in figure 1C is a second region (or portion, or segment, or block) 118 of a track on the optical disk 102, containing control information embedded in wobble. The control information may be separate from the auxiliary information, as illustrated in figure 1C, or the control information may in included in the auxiliary information.

[0021] An example of auxiliary information encoded in wobble is decryption information. If decryption information is encoded in wobble, then the medium may need to specify whether a drive is permitted to send that part of the information encoded in wobble external to the drive. For example, in figures 1A and 1C, control information in region 118 may specify whether a drive is permitted to send auxiliary information in region 116 outside the drive.

[0022] For a specific example, one proposed format specifies auxiliary information in a data structure called Extended Format Information, encoded in wobble. Part of the Extended Format Information is a region called a Disk Key Block. The Disk Key Block includes decryption information. In accordance with a specific example of the first embodiment of the invention, a single bit in a control byte specifies whether a drive is permitted to send the decryption information in the Disk Key Block outside the drive. In the specific example, the control byte is encoded at a separate location from the Disk Key Block.

[0023] Figure 2 illustrates an example method. At step 200, a drive reads control data that is encoded in wobble. At step 202, the drive determines whether the value of the control data prohibits sending auxiliary data outside the drive. If export is permitted, then at step 204 the drive sends the auxiliary data outside the drive. At step 206, if export is not permitted, then the drive refuses to export the auxiliary data.

[0024] Some drives may not be able to read information encoded in wobble. If there is information in wobble that needs to be accessible by a large population of drives, it may sometimes be desirable for a writing drive to copy part of the information encoded in wobble to a writeable area of the medium. Alternatively, it may be desirable for a writing drive to copy a transform of information encoded in wobble to a writable area of the medium. As one example of transformed information, the data encoded in wobble may be encrypted when written to the writeable area, or the data in wobble may be an encrypted form of the data in the writeable area. As another example, the data encoded in wobble may be encoded in a different format when written. However, it may be desirable to prevent some information, for example decryption keys encoded in wobble, from being copied to a writeable area of the medium. For example, in figure 1C, a first value of control information in region 118 may specify that a writing drive is permitted to copy the auxiliary information in region 116 to the part of the disk used for user data, and a second value of the control information in region 118 may specify that the drive must not copy the auxiliary information in region 116 to the user data area on the disk. Alternatively or additionally, the control data may specify that a writing drive must copy the auxiliary data, or a transform of the auxiliary data, to the user data area, or may specify that copying the aux-

iliary data, or a transform of the auxiliary data, to the user area is optional.

[0025] Figure 3 illustrates an example method. At step 300, a drive reads control data that is encoded in wobble. At step 302, the drive determines whether the value of the control data prohibits copying of auxiliary data. If copying is prohibited, then at step 304 the drive does not copy the auxiliary data. If copying is not prohibited, then at step 306 the drive may copy the auxiliary data (or a transform of the auxiliary data) to a writeable area of the disk (the value of the control data may specify that copying is required, or may specify that copying is optional). If auxiliary data is copied to a writeable area of the disk, it is possible for the data to later become defective, overwritten, or modified. For example, the data could be overwritten or modified inadvertently by a non-compliant system, or maliciously in an attempt to subvert a control process, for example to undermine a copy protection system. Another useful control parameter in wobble is control data that specifies that a drive capable of reading the auxiliary data in wobble must verify that the copy of the auxiliary data in a writeable area of the medium is intact. For example, in figure 1C, a first value of control data in region 118 may specify that a reading drive must read auxiliary information in region 116 and compare the auxiliary data in region 16 to data in a predetermined region of the writeable area of the disk. Note that it is not necessary for the data in the writeable area of the disk to be identical to the auxiliary information, because the data in the writeable area may be a transform of the auxiliary data. A second value of the control information in region 118 may specify what the drive must do if the data in the writeable area is corrupted. Optionally, if the verifying drive is a writable drive, the parameter may specify that the verifying drive must re-copy the auxiliary data, or a transform of the auxiliary data, to the writeable area of the disk if the data in the writeable area is corrupted. Alternatively, for example, if the data in the writeable area is corrupted, the drive may be required to take some other action, such as refusing to read part of the disk.

[0026] Figure 4 illustrates an example method. At step 400, a drive reads control data in wobble. If verification is requested (step 402), then at step 404 a region of the auxiliary data in wobble (or a transform of the data) is compared to a region of data in the writeable area that is supposed to contain a copy of the auxiliary date. If the version in the written area is corrupted (step 406), then at step 408 the drive controller takes appropriate action. Step 402 is described as "requesting" because not all drives can read information encoded in wobble. The action specified by the control data may require verification if the drive can read information encoded in wobble.

Claims

1. An optical medium (102), comprising:

auxiliary information (116) encoded in wobble;
control data (118) encoded in wobble;
a writeable area (112), the writeable area having a predetermined region;
the control data (118) specifying that a compatible drive must compare (404) the auxiliary information encoded in wobble to data in the predetermined region of the writeable area (112).

2. The medium of claim 1, the control data (118) further specifying that when the data in the predetermined region of the writeable area (112) is corrupted, then the drive is requested to copy the auxiliary data (116) to the predetermined region of the writable area.

3. The medium of claim 1, the control data (118) further specifying that when the data in the predetermined region of the writeable area (112) is corrupted, then the drive is requested to copy a transformed version of the auxiliary data (116) to the predetermined region of the writable area (112).

4. A drive for optical media, comprising:

a controller, the controller comparing information, encoded in a region (116) of wobble on an optical medium, to data in writeable area (112) on the optical medium, when control data encoded in wobble specifies that the controller is requested to compare (404) the information.

5. A method, comprising:

reading, by a drive (100), control data (118) encoded in wobble on an optical medium (102);
verifying, by the drive (100), that information in a writeable area (112) of the optical medium and information encoded in wobble on the optical medium (102) are consistent, when comparison is specified by the control data (118).

6. The method of claim 5, further comprising:

copying, by the drive (100), the information encoded in wobble on the optical medium (102) to the writeable area (112) of the optical medium, when the information in the writeable area (112) of the optical medium is not consistent with the information encoded in wobble on the optical medium (102).

Patentansprüche

1. Optisches Medium (102), umfassend:

Hilfsinformationen (116), die in einem Wobble codiert sind;

Steuerdaten (118), die in einem Wobble codiert sind;
einen beschreibbaren Bereich (112), wobei der beschreibbare Bereich eine vorbestimmte Region hat,
wobei die Steuerdaten (118) vorgeben, dass ein kompatibles Laufwerk die in einem Wobble codierten Hilfsinformationen mit Daten in der vorbestimmten Region des beschreibbaren Bereichs (112) vergleichen (404) muss.

2. Das Medium nach Anspruch 1, wobei die Steuerdaten (118) des Weiteren vorgeben, dass, wenn die Daten in der vorbestimmten Region des beschreibbaren Bereichs (112) beschädigt sind, das Laufwerk angewiesen wird, die Hilfsinformationen (116) in die vorbestimmte Region des beschreibbaren Bereichs zu kopieren.

3. Das Medium nach Anspruch 1, wobei die Steuerdaten (118) des Weiteren vorgeben, dass, wenn die Daten in der vorbestimmten Region des beschreibbaren Bereichs (112) beschädigt sind, das Laufwerk angewiesen wird, eine umgewandelte Version der Hilfsinformationen (116) in die vorbestimmte Region des beschreibbaren Bereichs (112) zu kopieren.

4. Laufwerk für optische Medien, umfassend:

einen Controller, wobei der Controller Informationen, die in einer Wobble-Region (116) auf einem optischen Medium codiert sind,
mit Daten im beschreibbaren Bereich (112) auf dem optischen Medium vergleicht, wenn in einem Wobble codierte Steuerdaten vorgeben, dass der Controller angewiesen ist, die Informationen zu vergleichen (404).

5. Verfahren, umfassend:

Lesen von in einem Wobble auf einem optischen Medium (102) codierten Steuerdaten (118) durch ein Laufwerk (100);
Verifizieren durch das Laufwerk (100), dass Informationen in einem beschreibbaren Bereich (112) des optischen Mediums mit in einem Wobble auf dem optischen Medium (102) codierten Informationen übereinstimmen, wenn ein Vergleich durch die Steuerdaten (118) vorgegeben ist.

6. Das Verfahren nach Anspruch 5, des Weiteren umfassend:

Kopieren der in einem Wobble auf dem optischen Medium (102) codierten Informationen in den beschreibbaren Bereich (112) des optischen Mediums durch das Laufwerk (100), wenn die Informationen im beschreibbaren Bereich (112) des optischen Mediums nicht mit den in einem Wobble auf dem optischen Medium (102) codierten Informationen übereinstimmen.

Revendications

1. Support optique (102), comprenant :

des informations auxiliaires (116) codées par ondulation ;
des données de commande (118) codées par ondulation ;
une zone inscriptible (112), la zone inscriptible ayant une région prédéterminée ;
les données de commande (118) spécifiant qu'un lecteur compatible doit comparer (404) les informations auxiliaires codées par ondulation à des données dans la région prédéterminée de la zone inscriptible (112).

2. Support selon la revendication 1, les données de commande (118) spécifiant en outre que lorsque les données dans la région prédéterminée de la zone inscriptible (112) sont corrompues, alors il est demandé au lecteur de copier les données auxiliaires (116) sur la région prédéterminée de la zone inscriptible.

3. Support selon la revendication 1, les données de commande (118) spécifiant en outre que lorsque les données dans la région prédéterminée de la zone inscriptible (112) sont corrompues, alors il est demandé au lecteur de copier une version transformée des données auxiliaires (116) sur la région prédéterminée de la zone inscriptible (112).

4. Lecteur pour supports optiques, comprenant :

un contrôleur, le contrôleur comparant des informations, codées dans une région (116) d'ondulation sur un support optique, à des données dans une zone inscriptible (112) sur le support optique, lorsque des données de commande codées par ondulation spécifient qu'il est demandé au contrôleur de comparer (404) les informations.

5. Procédé, comprenant :

la lecture, par un lecteur (100), de données de commande (118) codées par ondulation sur un support optique (102) ;
la vérification, par le lecteur (100), que des informations dans une zone inscriptible (112) du support optique et des informations codées par ondulation sur le support optique (102) sont co-

hérentes, lorsqu'une comparaison est spécifiée par les données de commande (118).

6. Procédé selon la revendication 5, comprenant en outre :

la copie, par le lecteur (100), des informations codées par ondulation sur le support optique (102) sur la zone inscriptible (112) du support optique, lorsque les informations dans la zone inscriptible (112) du support optique ne sont pas cohérentes avec les informations codées par ondulation sur le support optique (102).

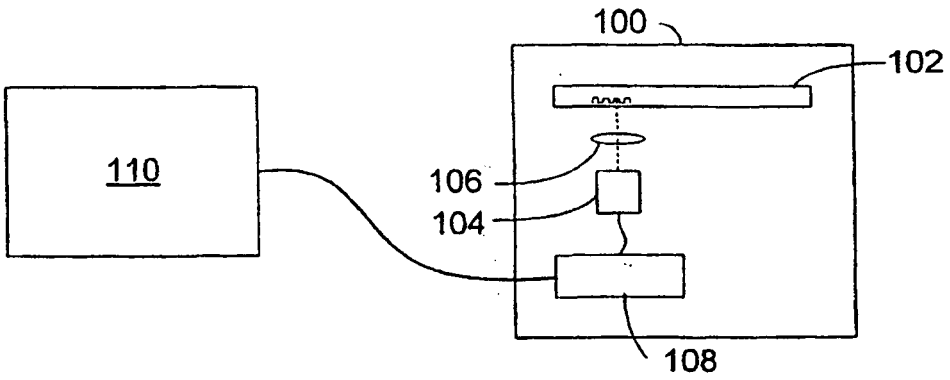

FIG. 1A

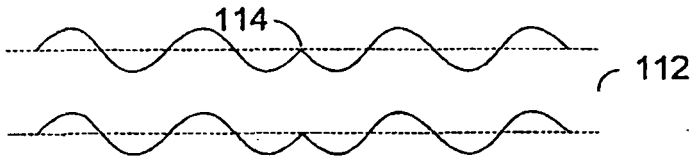

FIG. 1B

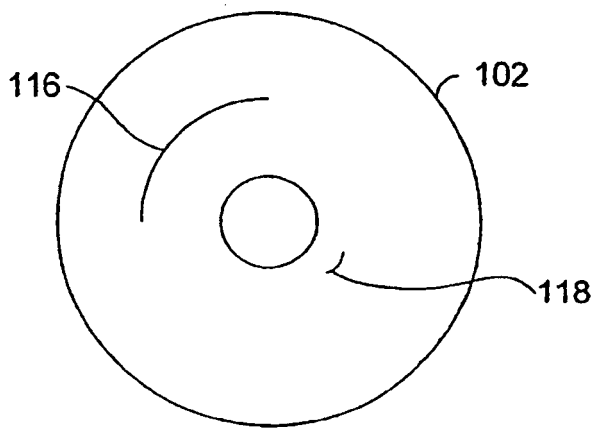

FIG. 1C

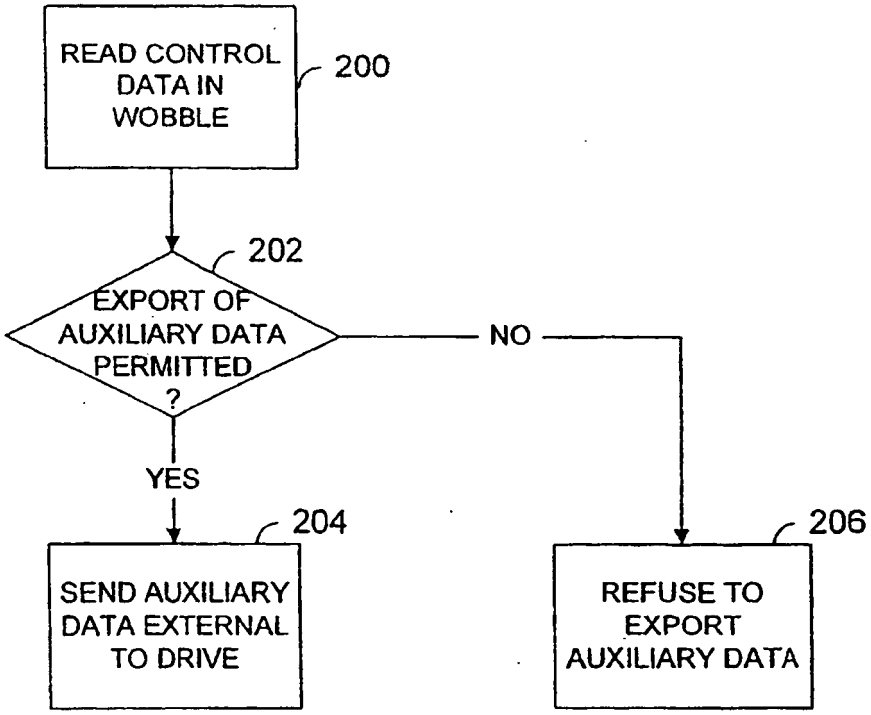
READ CONTROL DATA IN WOBBLE
200
202
EXPORT OF AUXILIARY DATA PERMITTED ?
NO
YES
204
SEND AUXILIARY DATA EXTERNAL TO DRIVE
206
REFUSE TO EXPORT AUXILIARY DATA

FIG. 2

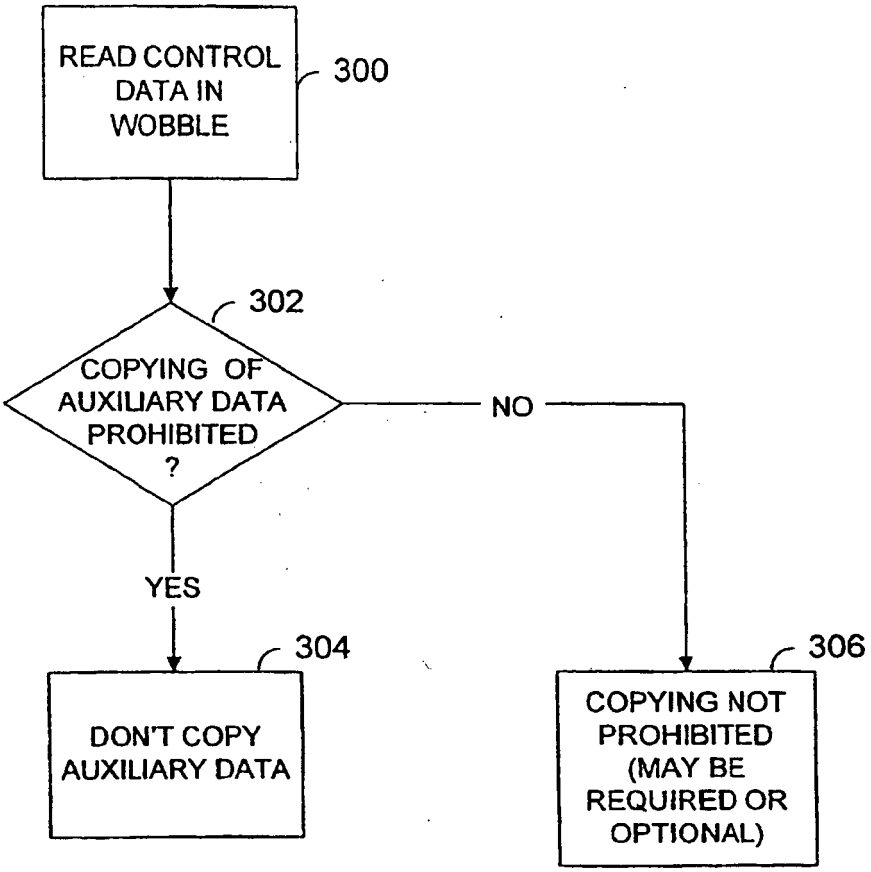
READ CONTROL DATA IN WOBBLE
300
302
COPYING OF AUXILIARY DATA PROHIBITED ?
NO
YES
304
DON'T COPY AUXILIARY DATA
306
COPYING NOT PROHIBITED (MAY BE REQUIRED OR OPTIONAL)

FIG. 3

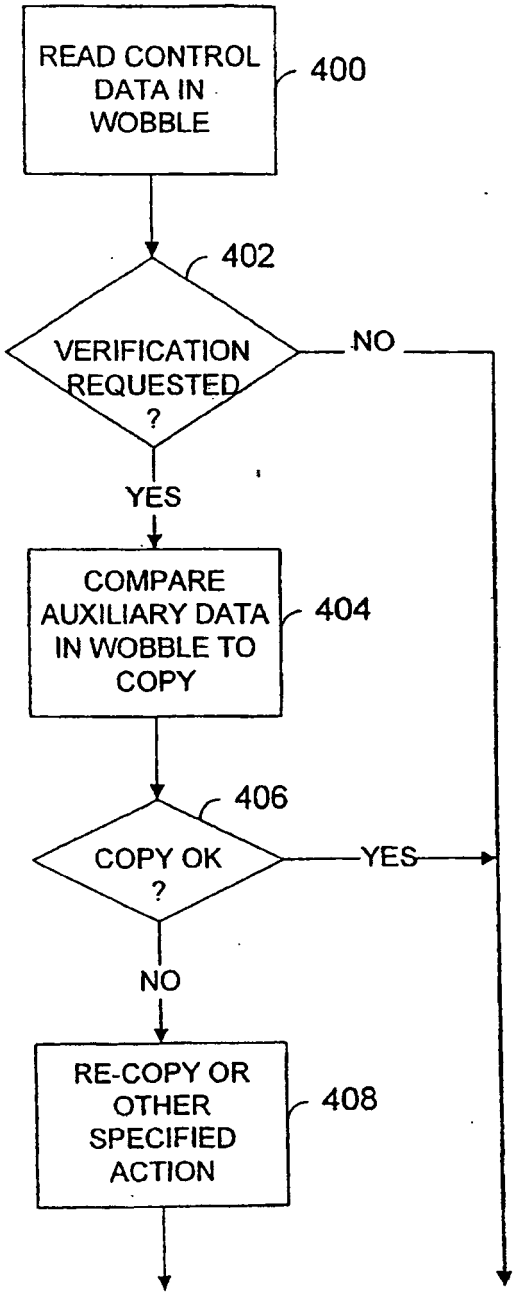
READ CONTROL DATA IN WOBBLE
400
402
VERIFICATION REQUESTED ?
NO
YES
COMPARE AUXILIARY DATA IN WOBBLE TO COPY
404
406
COPY OK ?
YES
NO
RE-COPY OR OTHER SPECIFIED ACTION
408

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

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- EP 0997899 A2 **[0004]**
- WO 2004095439 A1 **[0005]**